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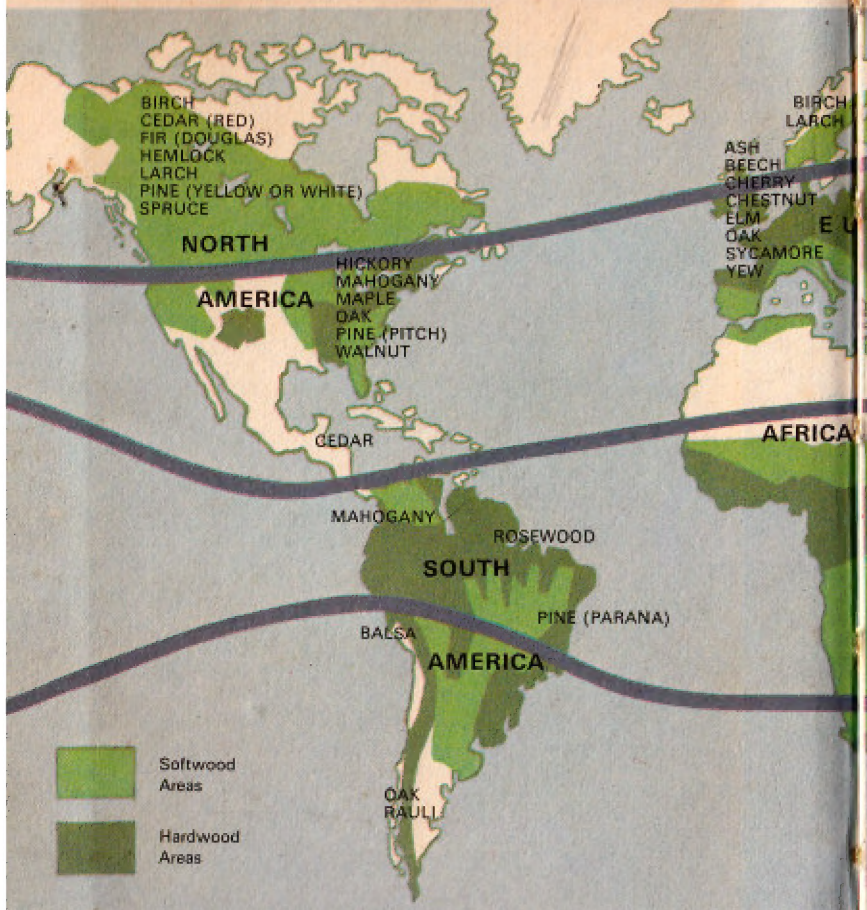

CONIFEROUS—SOFTWOOD

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Pine (Red)	
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Agba	Chestnut	Mahogany (African)	Rauli	
Ash	Ebony	Mansonia	Rosewood	
Balsa	Elm	Maple	Sapele	
Beech	Elm (Jap)	Oak	Sycamore	
Birch	Hickory	Oak (Jap)	Teak	
Blackbean	Jarrah	Obeche	Utile	
Cedar	Limba	Padauk	Walnut	

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Woodwork is one of Man's oldest and most enjoyable crafts. This carefully planned and beautifully illustrated book provides — at a price everyone can afford — a wealth of background knowledge and instruction which will be invaluable to the beginner, young or old.

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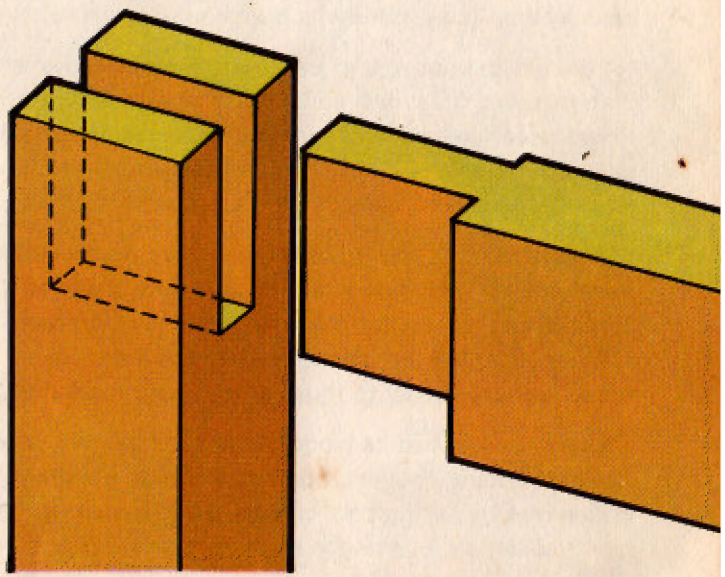
With love. From Aunty and Uncle Kapoor.

Woodwork

by BRIAN LARKMAN
with illustrations by GERALD WITCOMB



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The history of wood

Wood has played an important part in the history of man. It provided primitive man with shelter, weapons and transport. His crude hut of saplings, covered with branches and skins, developed into homes of many kinds; log cabin, fortress, timber-framed cottage, half-timbered town house, chalet, bungalow, prefabricated building, even the caravan. Inside the dwelling, wood was used for chairs, tables and beds in many styles through many thousands of years.

Among man's weapons, spears, shields, bows, catapults and battering rams and even warships and aeroplanes were made of wood; weapons which were used to shape history.

Primitive man used logs as rollers to move heavy loads, then followed the wheel and the use of wood in transport. It was used for carts and coaches, carriages and bicycles, galleons and barques, clippers and steamships, sleighs and skis, aeroplanes and gliders; the list is almost endless.

The hand tools for woodworking have developed side by side with the use of wood as a raw material. It is surprising to realise that the basic form of many tools has changed little through the ages. Many of the tools we use today are very similar to those used by our forefathers.

Every age has had its woodworkers; carpenters, joiners, cabinet makers, coopers, boatbuilders and wheelwrights, patternmakers, sculptors, carvers and toymakers. Each new generation inherits the store of knowledge and skills of previous generations.

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Wood today

In spite of the development of many new, 'man-made' synthetic materials, wood remains a very important raw material. Traditional uses in building and in the home are largely unchanged, but technical advances and the demands of modern mass-production have led to new methods of working in wood.

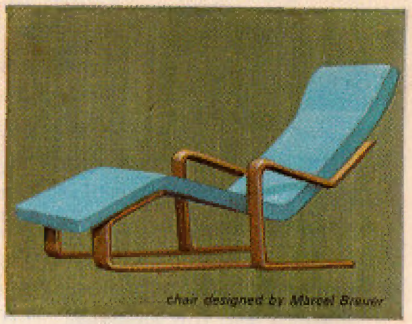
The development of machines capable of producing large quantities of manufactured boards such as plywood, blockboard, chipboard and hardboard has given designers and engineers wide scope to develop new ideas and techniques. Plywood can be used to make canoes and sailing dinghies of light weight but great strength. Plywood can also be moulded to form shells for chairs and TV cabinets. Chipboard and blockboard, veneered with wood or plastic laminates, are used to mass-produce good, inexpensive furniture and kitchen units.

Modern adhesives which give quick and immensely strong bonds have led to the development of the technique of lamination. Like plywood, laminating involves gluing layers of wood together to form shapes and sizes impossible to achieve in any other way. Massive portal frames for buildings, with exciting sweeps and curves and tremendous strength, can be constructed. Shapes for chair frames and table legs can also be laminated.

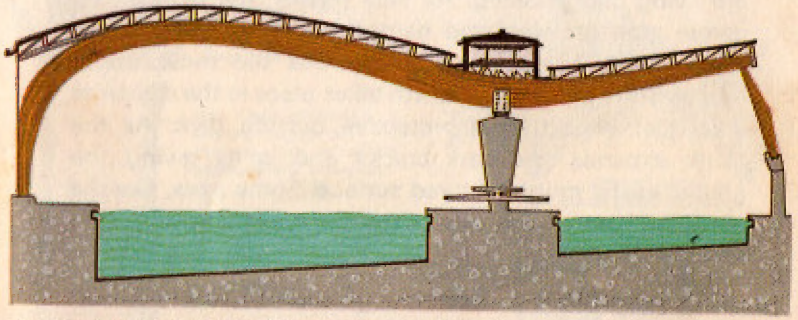
In furniture factories and elsewhere designers have developed a wide range of special woodworking machines, saws of all kinds, planers and sanders, spindle cutters and moulding machines, dowelling and dovetailing machines, hydraulic and pneumatic cramping devices and special heating equipment to speed the setting of glues.

The home craftsman engaged on 'do-it-yourself' jobs about the house now has labour-saving power drills, saws and sanding machines.

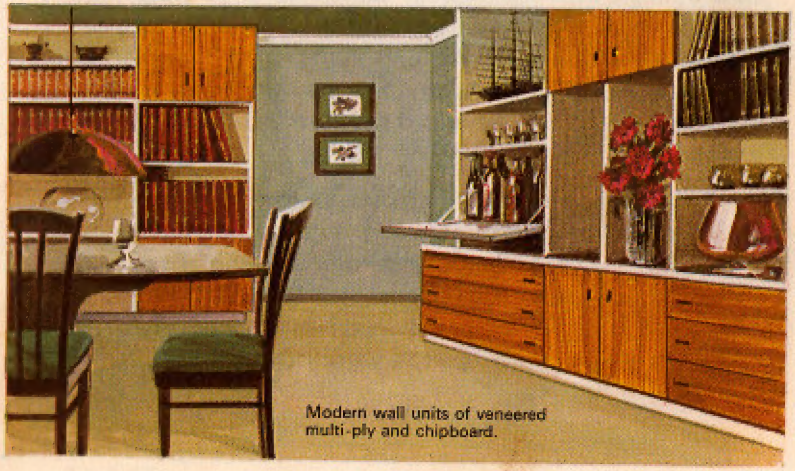
Sailing dinghy with plywood hull



Laminated beech chair



A cross-section showing one of the many laminated timber frames used in the structure of a swimming bath at the National Institute of Sport, Paris.



Modern wall units of veneered multi-ply and chipboard.

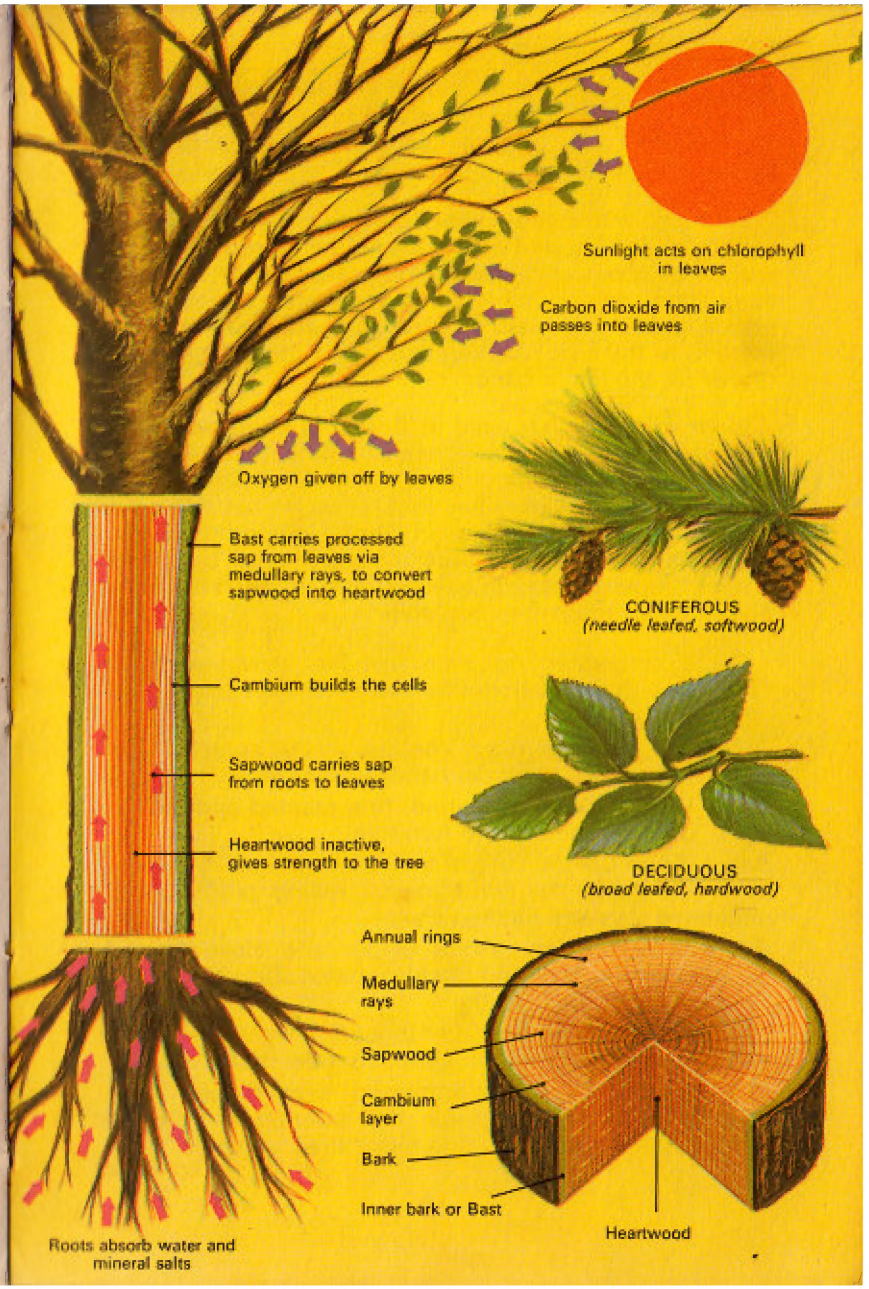
How a tree grows

Trees are the tallest living things, some reaching heights of 400 feet. Some trees are hundreds of years old. Each year a tree forms new cells and the trunk expands in circumference. These *annual rings* of growth enable us to calculate fairly accurately the age of a felled tree. Many factors influence the growth of a tree; much depends upon the soil and the position in which it grows, the climate and the weather.

Most of the trunk is *sapwood*, cells of cellulose which are living and growing. As time passes, the cells in the centre stop growing and harden off to form the tough *heartwood*. This heartwood provides the most useful timber. The most active growth takes place in the *cambium* layer just beneath the protective outside *bark*. As the trunk expands, the bark cracks and splits giving the characteristic rough textured surface. Some trees, like the silver birch and plane, have a smooth bark that peels off in layers.

The juice-like *sap* rises through the tree to the leaves, where the action of the sunlight on the chlorophyll (the green matter of the leaves) combines with water and carbon dioxide to form *elaborated sap*. This processed sap travels back down the tree and is the 'food' upon which the tree lives. The *medullary rays* are thin tubes or ducts through which the elaborated sap travels into the heart of the trunk.

Timber is divided into two main groups – hardwoods and softwoods. These classifications can be misleading because they are botanical and not necessarily anything to do with the working characteristics of the wood. Balsa, for example, is classed as a hardwood whilst some softwoods are very tough and difficult to work.



More about timber

Not all trees provide timber suitable for woodworking. Although there are many species, only a few are available commercially.

Each timber has its own characteristics : colour, strength, weight, durability and so on. Some bend easily without snapping, some carve well, some are oily or resinous, some take paint well, others are water and weather resistant. Some woods have beautiful grain patterns. The first job of the woodworker is to select the most suitable timber for the job in hand.

Most of the timber used in Britain is imported. Hardwoods arrive from the temperate climate of Central Europe and the tropical forests of West Africa, Central and South America and the Asian Far East. Most softwoods come from the cool northern parts of Europe, around the Baltic, Scandinavia and Russia. Britain, once covered by forests, is not a timber-producing country ; only limited amounts of home-grown timber are available.

Some timbers in common use are shown opposite together with the purposes for which they are best suited, others include :

Ash: European hardwood. Very tough but springy. Used for cricket stumps, hammer handles and ladders.

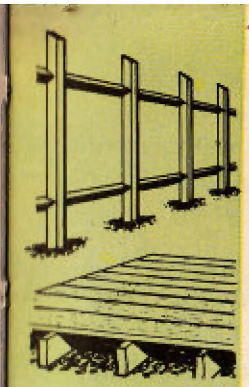
Agba: West African hardwood, fine grained and easy to work. Used for joinery and furniture.

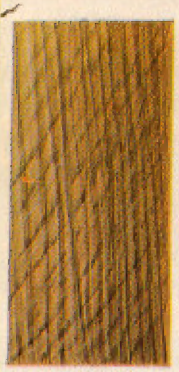
Beech: From Central Europe. Very close grained. Clean and hygienic. Useful for breadboards, rolling pins, spoons, unpainted toys and kitchen chairs.

Birch: Scandinavian. White colour and close grained. Mainly used for plywood but also match sticks and match boxes.

Obeche: A hardwood but soft to work. Pale yellow colour and free from knots. Often used in school craftwork.

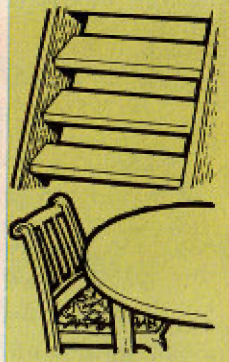
Western Red Cedar: A softwood from Canada. Very weather resistant. Used for the external cladding of buildings and special roofing tiles called 'shingles'.



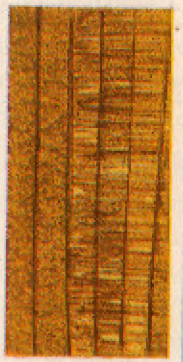


Oak

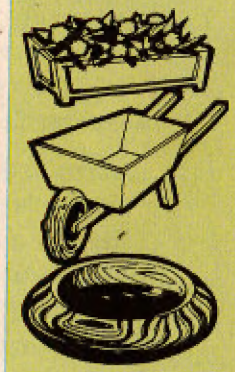
Mahogany



Teak

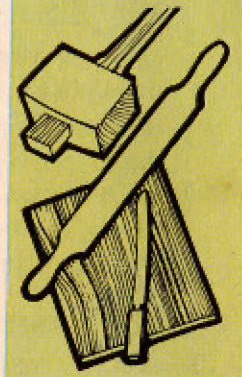


Elm



Red Baltic Pine
(Red Deal)

Beech



Conversion of timber

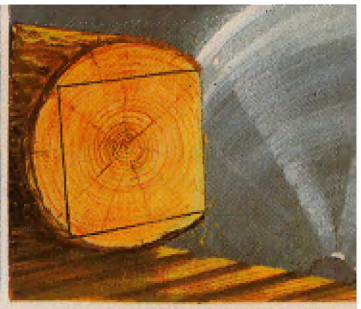
About one-fifth of the earth's surface is forested and man is continually exploiting these forests. Because the supply is not inexhaustible, in recent years softwoods have been cultivated as a crop in many parts of the world.

Most trees are felled with motorised chainsaws. The branches are then stripped off and the trunk goes to the nearest sawmill or docks. In some parts of the world the logs are floated down rivers as great rafts. Elsewhere elephants, giant tractors, lorries or specially equipped trains are used. At the sawmills, before or after export, the trunks are converted into useful sizes and shapes. Often a trunk is reduced to a square baulk ; this removes a lot of the useless waste and makes the timber easier to handle.

A simple 'through and through' cut is usual. This results in very little waste but planks cut in this way are very prone to warping, creating problems later for the wood-worker. Hardwoods which are used for furniture making and other decorative work are converted by tangential sawing or quarter cut. These two cuts produce a variety of sizes and show off the grain pattern ('figure') to best effect ; the wood is also less likely to warp.

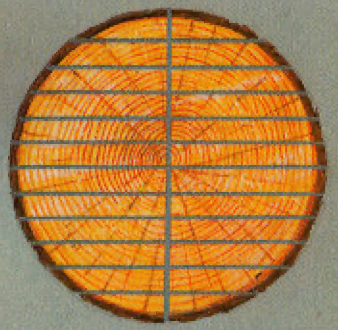
At the sawmill the timber is carefully checked for defects such as splits along the grain, called 'shakes', and for decay caused by fungi or insect attack. After seasoning the timber is further converted into standard sizes, each cross-section having a special name : plank, deal, board, batten, square, scantling and so on. Many of these are machine-planed before sale.

Logs floating down river

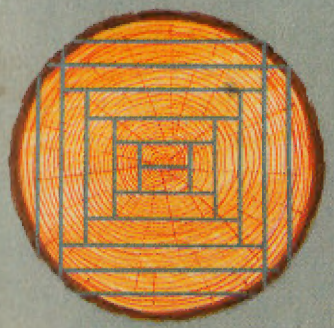


A baulk being cut

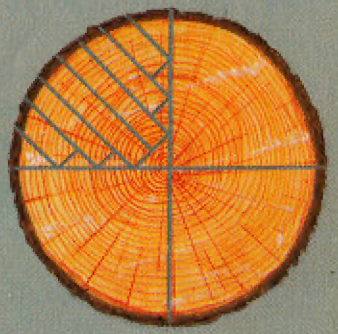
1 Baulk



2 Through and through cut



3 Tangential cut



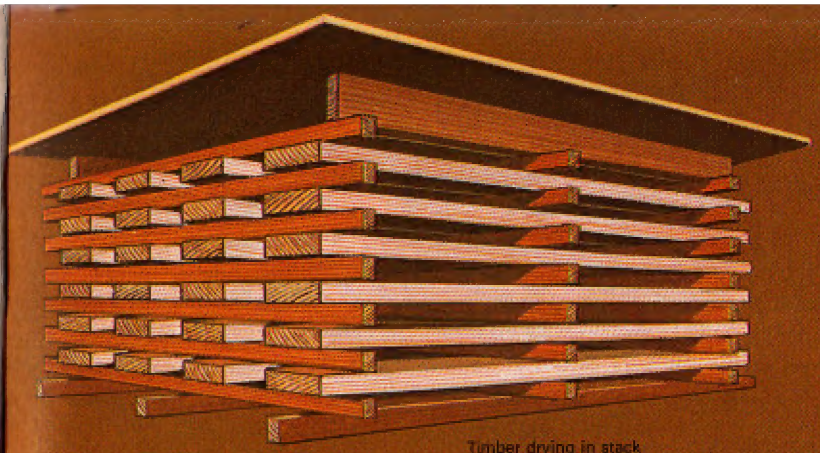
4 Quarter cut

Seasoning

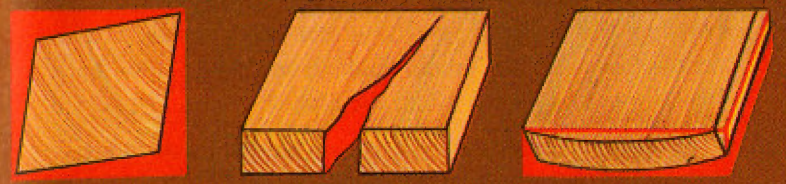
Timber contains a great deal of moisture when felled. In this state the wood is called 'green'. The moisture content makes sawing difficult and planing almost impossible. Green wood also shrinks and splits. To overcome these problems timber undergoes controlled drying-out known as *seasoning*.

Seasoning can be done in two different ways: *Natural seasoning* in the open air. The boards are stacked carefully with 'sticks' (1"×1"/25mm square) between them. This allows a good circulation of air. Each stick is placed directly above the one below, otherwise the boards sag under their own weight. The whole stack is supported off the ground on baulks or brick piers. A sloping roof keeps out rain and direct sun. Natural seasoning is very slow and can take many months, even years, to complete. To speed up the process, natural seasoning is sometimes combined with the second method – *kiln seasoning*. This takes place in a brick-built kiln. The boards are stacked, in 'stick', on trolleys. Inside the kiln, controlled amounts of steam and blown hot air gradually reduce the moisture content. The whole process takes only a few weeks.

To keep the wood fairly stable, a small percentage of moisture is retained. Even carefully seasoned timber can cause the woodworker problems that have to be considered in the design and construction of jobs. Warping is the most serious defect in wide boards. Smaller sections twist along their length or curve and bow. Careful storage in cool but dry surroundings is best.



Timber drying in stack



Shrinking — End shakes — Warping

Boards always tend to warp away from heart.

Heartwood of branch produces knot.

Twisting — Winding — Bowing

Plywood

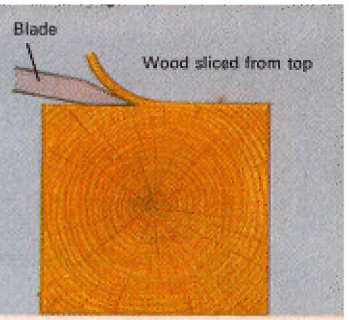
Planks and boards contain a certain amount of moisture even after seasoning. This can cause them to twist and warp as they dry out. Warping makes accurate work difficult.

If, for example, a wide piece of wood is needed to make a table top, several boards would have to be joined together edge to edge. To overcome this disadvantage, special kinds of manufactured boards are made, the most common of which is plywood. Plywood is made up of layers, or laminations, of wood glued together, the grain of each layer running in the opposite direction to the next. This is why plywood looks alternately light and dark on the edges. Gluing the layers in this way prevents the wood from twisting and warping; it makes the sheet stable. It also means that saw cuts can be made in any direction without the danger of splitting along the grain.

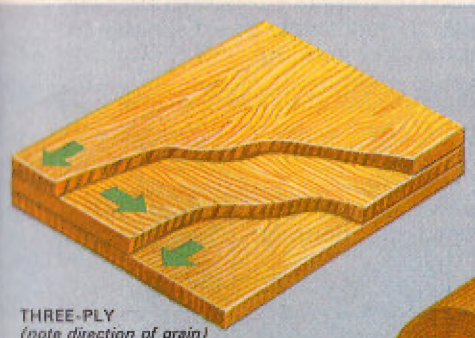
Plywood is made in large sheets, usually 8′×4′ (2440×1220mm), and in several thicknesses. The large sheets make edge jointing unnecessary. Sometimes the two outside layers have veneers of beautiful, rare and expensive timbers.

The ply layers are cut in one of two ways. In each the log is steamed first to soften it up. In the first method it is mounted on a giant, lathe-like machine where a large blade cuts and unrolls it rather like a reel of paper. In the second method, the log is squared-up and slices are taken from the top. After cutting, the layers are sorted, the best being used on the outside. Glue is applied by rollers and then the sheet is squeezed in a heated press until the glue sets.

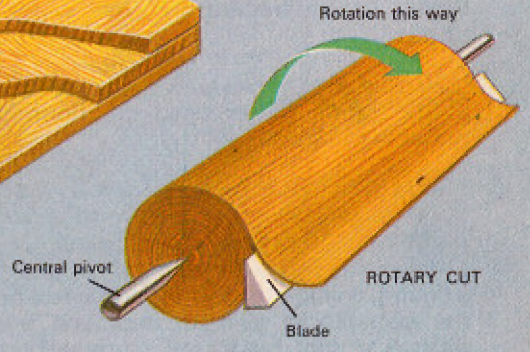
Logs steamed to soften before layers cut.



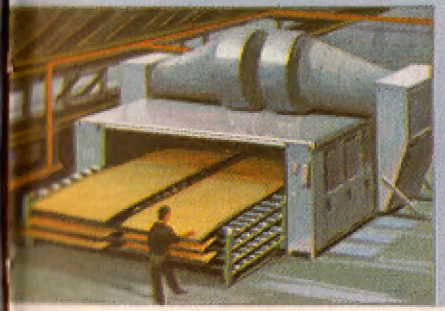
KNIFE CUT



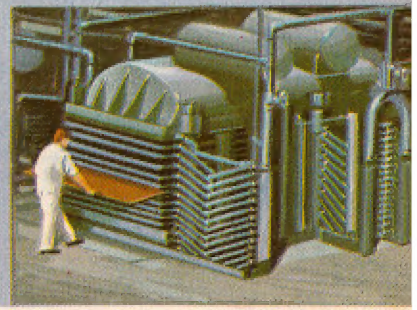
THREE-PLY
(note direction of grain)



ROTARY CUT



An automatic dryer.



Bonding the resin coated layers.

Other manufactured boards

Cheap plywoods, such as those from which tea-chests are made, have an extra thick centre layer known as *stoutheart.*

Multi-plys over $\frac{3}{4}$" (18mm) in thickness are expensive to produce and very heavy. Over this thickness, cheaper, lighter alternatives are used.

Laminboard has a core made of $\frac{5}{16}$" (7mm) wide strips of softwood between two facings of thick $\frac{3}{16}$" (3mm) veneers, the grain of which runs at right angles to the core. This produces a high quality, very stable board suitable for decorative veneering in furniture making.

Blockboard is also used in furniture making. It is very similar to laminboard but has wider (1"/25mm) core strips.

Battenboard has even wider strips (over 3"/80mm). It is a low grade board used for flooring, shuttering and portable buildings.

Chipboard is a recently introduced material resulting from the development of new adhesives. Wood particles from waste, offcuts and small, otherwise useless trees are mixed with synthetic resins and compressed. This produces a strong, cheap board. Often extra-fine particles are used on the surfaces to give an improved finish. Chipboard is difficult to joint, but for table tops and simple furniture such as book-shelves, veneered chipboard is ideal. Like all other boards, the exposed edges must be veneered or lipped with a strip of wood.

Hardboard is a versatile, thin ($\frac{1}{8}$" to $\frac{1}{4}$"/2-6mm), cheap sheet material. It is made from waste wood, chipped and shredded and pulped, mixed with resins then heated and compressed. Hardboard has one smooth face and one textured. For jobs that require painting, kitchen cabinets for example, special oil-tempered hardboard is best.

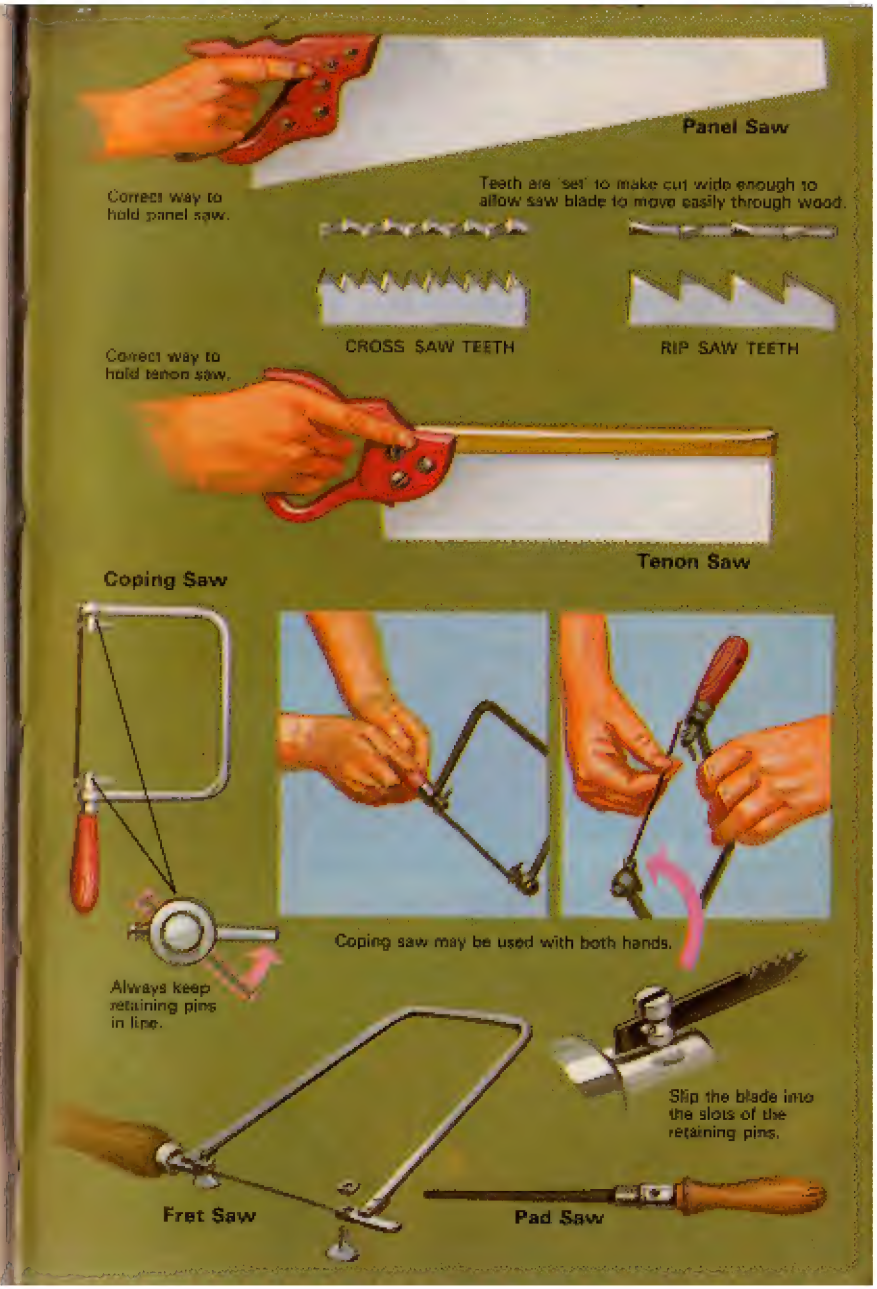
Saws and sawing

Nearly every woodwork job begins with sawing. Most households have a woodwork saw of some kind. The most common saw is the *tenon saw*, often called a backsaw because of the steel or brass strip along the top edge which stiffens-up the thin blade. Without this 'back' the blade would soon twist and buckle. The back prevents deep cuts being made and this indicates that the saw is best for cutting thin wood and joints.

A backsaw with between 12 and 16 teeth per inch (25mm) is a tenon saw; if it has as many as 20 teeth per inch it is a *dovetail* saw for very fine work.

A much larger saw without a back is a *panel saw* or *handsaw*. Used for heavy work it can make long, deep cuts. There are two kinds of handsaw, the *rip saw* which is used for cutting along the grain of the wood, and the *cross-cut saw* which is used mainly for cutting across the grain. The different kinds can be identified by carefully examining the shape of the teeth. A ripsaw has about five teeth per inch and the cross-cut up to ten.

Accurate sawing is essential in the production of good quality work. Like every other tool operation, skill and accuracy improve with practice.



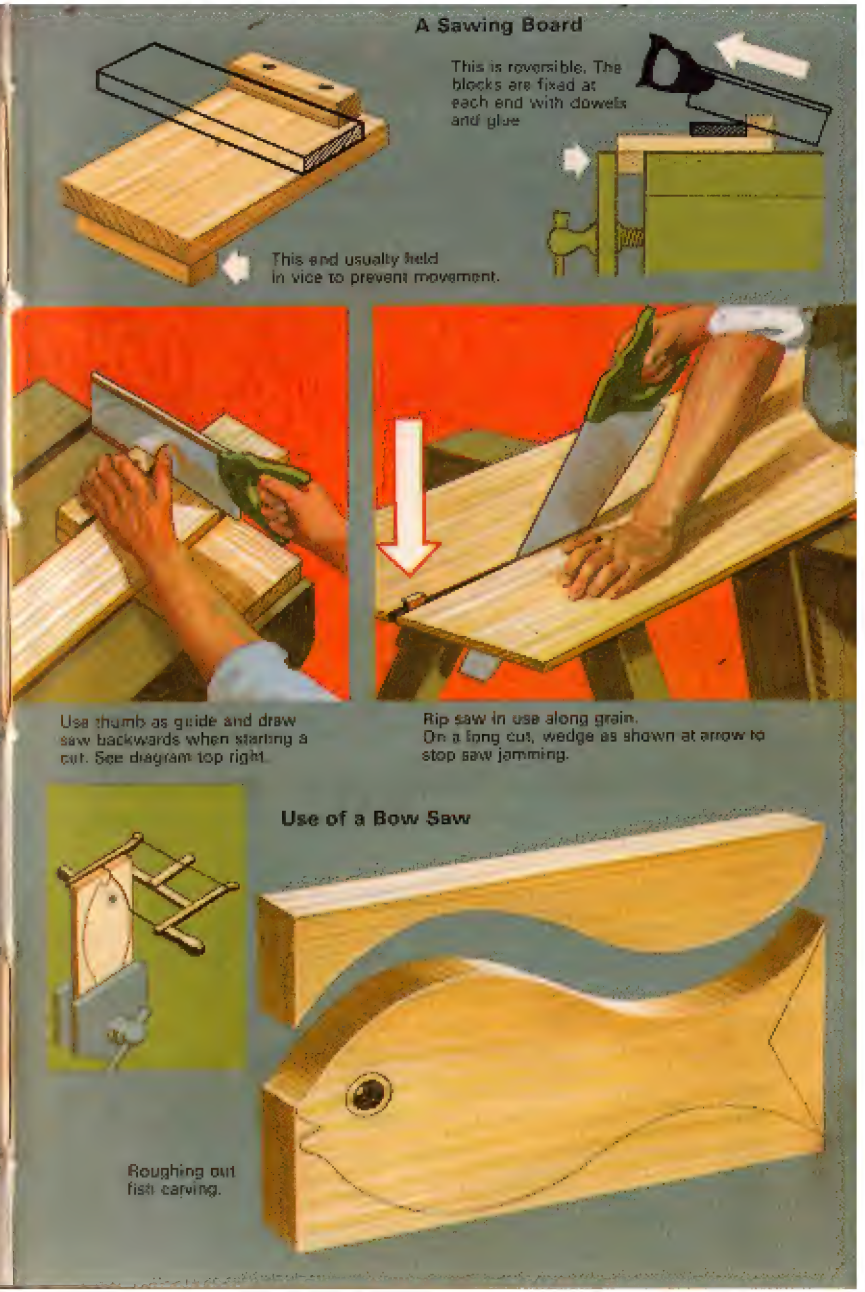
Saws and sawing

When handsawing, the wood is usually supported on a trestle, sometimes called a 'sawing horse'. The first problem is to get the saw started on the line; obviously a good start ensures a straight cut. A useful technique is to draw the saw lightly backwards first to produce a 'nick', then, keeping the blade at a shallow angle, make the first few careful strokes. Once 'on line' the saw handle can be raised until the most efficient cutting angle is found.

For tenon sawing, the wood must be firmly held either in a vice or held down with cramps. Often a simple sawing board (bench hook) is used. The technique of starting with a backward stroke, guiding the blade with the thumb, is also useful. All tenon saw cuts are made on the *waste side* of the gauge or marking knife lines.

When using any kind of saw, a handgrip with the forefinger pointing along the length of the saw will increase control and precision.

For some jobs special saws are required. Curved cuts can be made with *bow saws, coping saws* and *fret saws*. Generally the bow saw works best on thick wood and the coping saw and fret saw on plywood and hardboard. The coping saw is also useful when removing waste when cutting dovetail joints. With all frame saws it is important to keep the blade in line all the time. If it is allowed to twist it will jam in the cut and break. For small awkward holes a *padsaw*, sometimes called a *keyhole saw*, is useful.



Marking-out

Accurate measuring and marking-out is essential. A most important tool is the *rule*. There are three main kinds; the carpenter's folding, boxwood rule; the 'push and pull' metal tape in a compact case, and the steel rule. All woodwork rules have a zero end, where the dimensions start at the very end, a useful feature when checking internal dimensions.

When saw or chisel cuts are to be made *across* the grain of the wood, the surface fibre must first be cut with a *marking knife*. This ensures an accurate start for the chisel and a clean, splinter-free finish on the underside when sawing. Make *only one* clean cut with the marking knife, otherwise accuracy is lost.

Marking-out parallel to edges, and *along* the grain, requires a *marking gauge*. Beginners always find this a difficult tool. The secret is to push the stock hard up against the wood and then to trail or drag the spur lightly over the surface. This prevents the spur following the grain and producing a wavy line. A special gauge with two spurs is used for marking-out mortise and tenon joints.

A pencil is used where gauge or knife lines would spoil a finished surface. A soft pencil, HB or B, sharpened to a fine point is best.

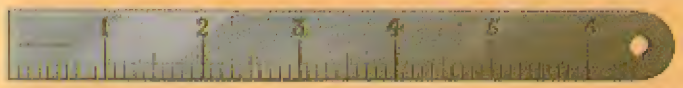
Try squares are accurately set to right-angles (90°) and used in marking-out and for testing (*trying*) for squareness when planing and when assembling joints. When using a try-square with a marking knife, it is best to cut along the outside edge of the try square blade. The *mitre square* is set to an angle of 45° (and 135°). A *sliding bevel* can be set up to any angle, the long slot in the blade making many settings possible. It is useful for copying angles and often used when marking-out dovetail joints.

Marking Gauge

marking with grain

tilting the gauge to trail the spur

measuring

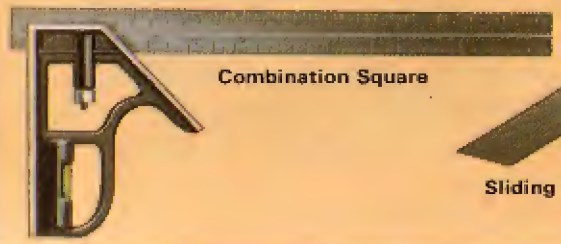


Steel Rule *(no waste measure on end)*

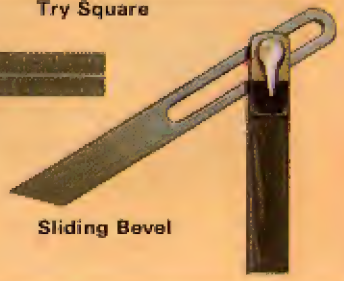
Using marking knife to mark across grain

Marking Knife

Try Square



Combination Square



Sliding Bevel

Planes and planing

Planes reduce wood to required sizes by shaving away thin layers. Apart from the special planes shown on page 29, there are three main types of hand plane – the try plane, jack plane and smoothing plane. All three are similar in appearance, only the length varies.

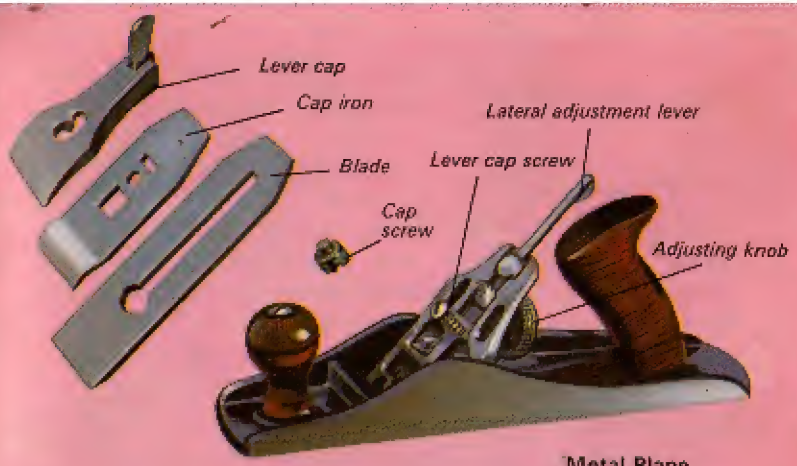
Try planes are between 18″ and 24″ long and used to 'true-up' large surfaces and long edges. *Jack planes* are shorter (14″-17″) and used for general purpose work. The *smoothing plane* (9″-10″) is for final finishing of surfaces, cleaning-up joints after glueing and working the hard end-grain.

Traditionally, planes were made of tough beech wood but recently metal planes have become popular. The main advantage of the metal plane is the ease and speed with which the blade can be adjusted. The brass adjusting nut lifts or lowers the blade. A lever provides lateral (sideways) adjustment. Metal planes must be treated with care as their cast-iron bodies are brittle.

The cap iron is important to the cutting action of the plane. It stiffens the thin blade and lifts the shaving. Always set the cap iron close to the cutting edge; about $\frac{1}{16}$″ (2mm) is usual.

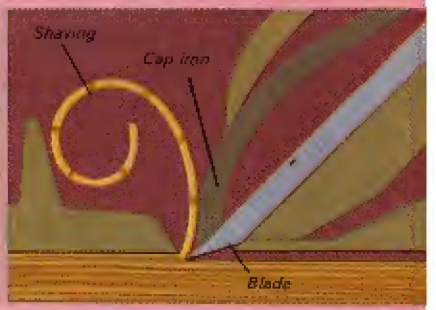
When planing, the wood must be firmly held in a vice or flat on the bench top, pushed hard up to a *bench stop*. Both hands are used to grip the plane, and the body must be behind the plane so that it is driven forward with a kind of punching action with the right hand.

Sometimes shavings clog the mouth of the plane. This indicates that the blade is incorrectly set. *Never* use a chisel or steel rule to unblock the plane; always dismantle the lever cap and remove the blade.



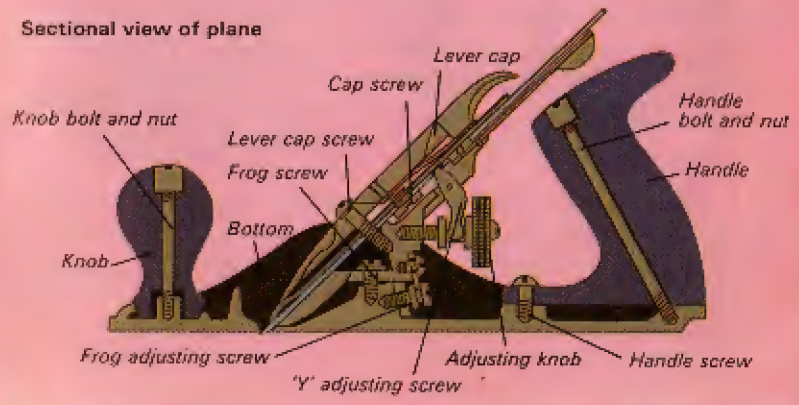
Metal Plane

How to hold plane - in use



Cap iron lifts and cracks shavings

Sectional view of plane



Special planes

There is a wide range of special planes available to do specific jobs.

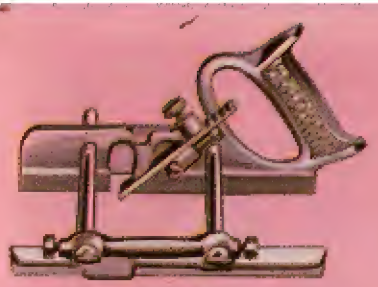
The *plough plane* is for cutting grooves along the grain to take plywood panels. A wide range of interchangeable blades (from $\frac{1}{8}$" to $\frac{9}{16}$" and metric equivalents) are supplied with the plane. Special cutters to make tongues for tongue and groove jointing are also included. An adjustable *fence* controls the distance between the edge of the wood and the groove and a *stop* determines the depth of the cut. The *shoulder plane* is very narrow and has a full width blade. This is useful for trimming the shoulders of large tenons and finishing rebates.

The *fillister rebate plane* is used to cut 'steps' (rebates) along the edge of a piece of wood to receive panels or glazing. Like the plough it has an adjustable fence and depth stop.

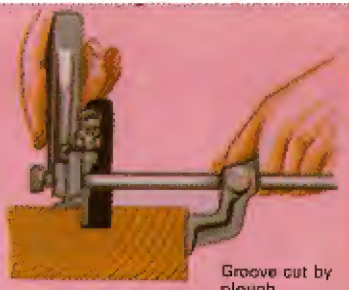
A *router,* of which there are several patterns, is for cleaning up housings, i.e. grooves *across* the grain. Housings are first sawn and then the waste is chiselled out, the router finishing the groove to a uniform depth.

The *spokeshave* is based on an ancient tool used by wheelwrights, hence its name. The modern version is made of metal and used for working on curves of all kinds. The flat-faced spokeshave is for convex curves and the round-faced for concave. It is important that all cuts are made 'down grain' if a clean finish is to be obtained.

All planes must be handled with care. They must be kept sharp and accurately set otherwise they will not work efficiently.



Plough Plane



Groove cut by plough

Tenons and shoulders

Shoulder Plane

Rebate Plane

Cutting a rebate

cutting action

Hand Router

Spokeshave

Two kinds A for convex curves
B for concave curves

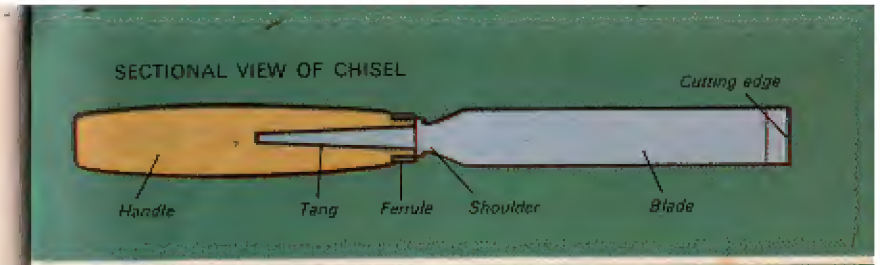
Chisels and chiselling

Chisels are available in many types and a large range of sizes. Each type has a special use. All chisel blades are made of *high carbon steel* which keeps a keen edge. Handles, traditionally made of boxwood or ash, are now frequently of tough, shatterproof plastic. The blade is usually fitted to the handle by a square, tapered *tang*.

A general purpose *firmer* chisel has a square-edged blade. Lighter and less robust is the *bevel-edged* chisel: this is useful for working on acute angles such as dovetail joints. For cutting mortise joints a special, strong, *mortise* chisel is used. This has a tapered blade to give extra strength when leverage is applied and also to withstand blows from the mallet. Often mortise chisels have a leather washer between the shoulder boss and the ferrule which acts as a shock-absorber. Some mortise chisel handles have a metal band to prevent them splitting. Chisels with curved blades for carving and wood-turning are called *gouges*.

Basically there are two kinds of chiselling:
Chopping, when the chisel is used vertically across the line of the grain and driven with a mallet to remove large chippings quickly.
Paring, to remove small shavings of wood, the chisel being pushed or driven with one hand whilst the fingers of the other hand restrain and control the cutting action.

Chisels are highly dangerous tools and must be used with utmost care. **Always** keep both hands **behind** the cutting edge. **Never** chisel towards your body. If possible, always fix down the work securely in a vice or with a G-cramp. When chopping a through mortise, protect the bench with waste wood. Store your chisels carefully and keep them sharp.



Cutting a dovetail housing

Paring

Chopping a mortise

Sharpening edge tools

Chisels and plane blades are made from high carbon steels containing 1% to 1.5% carbon. The carbon allows the metal to be hardened and tempered, tough enough to be sharpened to a fine cutting edge. Sharp cutting tools are essential for first class woodwork.

The cutting edge has two surfaces – the *grinding angle* reduces the thickness of the blade and the *sharpening angle* makes the sharp edge. Grinding and sharpening must be accurately done and requires skill. Seek expert help before experimenting.

Grindstones are of several varieties. Natural sandstone wheels use water as a lubricant to wash away particles of steel and keep the blades cool. Sandstones are gradually being replaced by power grinders with wheels of carborundum or aluminium oxide. Horizontally set wheels of artificial, open-grit stone need special oil coolants.

Sharpening is done on an oilstone; these can be natural stones or manufactured from aluminium oxides. A lubricant such as fine machine oil must always be used. **Never** sharpen on a dry stone. Sharpening needs lots of practice. The tool should be placed at a low angle and then slowly raised until the old sharpening edge angle squeezes out a line of oil along the edge. Using both hands, the wrists are '**locked**' in position to maintain the correct angle then long, steady strokes are made along the whole length of the stone. The edge must be checked frequently to see that a parallel cutting edge is being achieved. Sharpening produces a *burr* or *wire edge*. This is removed by turning the blade over and rubbing it flat across the stone, called *backing-off*. Special honing jigs are obtainable to help when sharpening.

Blades should be carefully wiped clean of oil before being used on clean wood. For sharpening gouges, shaped oilstones called *slips* are used.

Drills and drilling

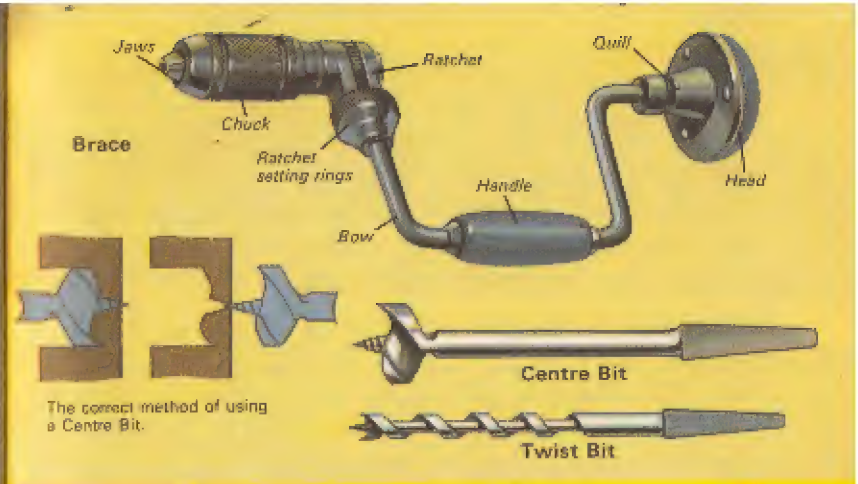
The *brace and bit* is for boring large holes. Many braces have a ratchet device which allows the tool to be used in confined spaces where a full sweep of the brace is impossible. The bits are held in the brace chuck by their square-shanked ends. Always ensure that the bit is straight and secure before starting to bore. There is a great variety of bits, some of which have very special functions; the *forstner bit*, for example, makes flat bottomed 'blind' holes.

Centre bits are used for large shallow holes. The screw centre draws the bit into the wood whilst the circumference is scribed by one cutting edge; a second cutting edge removes the waste. When boring through, the bit is taken in until the tip of the screw appears on the reverse side. The wood is then turned round and the hole completed. This prevents splitting.

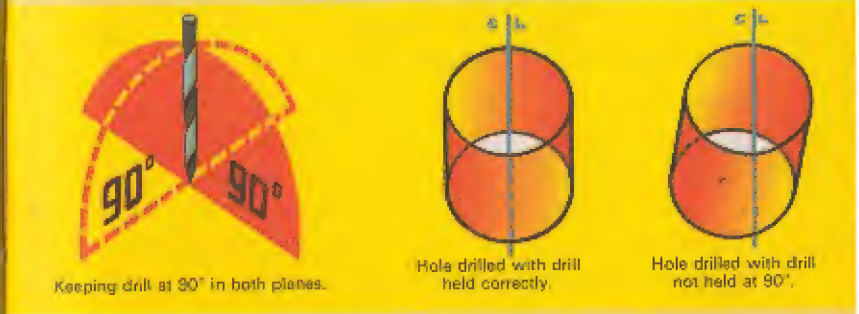
Twist bits are in common use, the Jennings pattern being the best known. A twist bit helps to ensure that deep holes are bored true. It is important that the bit enters the wood at right angles in two planes; some craftsmen stand a try-square alongside the bit as a guide.

Small holes ($\frac{5}{16}$"/8mm and under) are best drilled with a *hand drill*, sometimes called a wheel brace. This is ideal for screw holes. Twist drills are available in sizes down to $\frac{1}{16}$" (1.5mm). Two qualities are sold – H.S.S. (high speed steel) which are black in colour and expensive, or cheaper, shiny, C.S. (carbon steel). Wood sometimes clogs the *flutes* of a twist drill; it is sensible to clear this waste from time to time otherwise the drill may jam and break off.

Special counter-sinking drills open up the top of screw holes so that the screw head sets down flush with the surface.



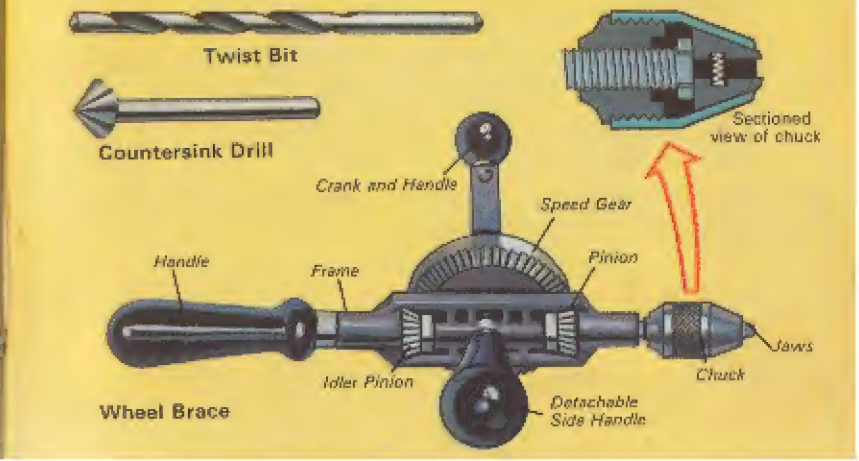
The correct method of using a Centre Bit.



Keeping drill at 90° in both planes.

Hole drilled with drill held correctly.

Hole drilled with drill not held at 90°.



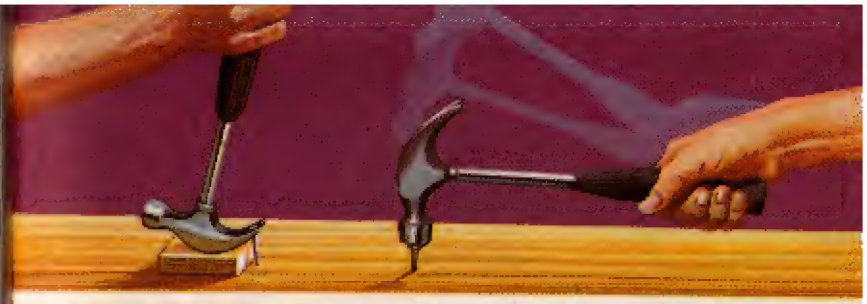
Hammers and mallets

Hammer heads are forged from specially made alloy steels. The *claw hammer* is a carpenter's tool for rough outside building work such as making roof trusses and erecting fences. The claw end is used to lever out nails. The *Warrington* type of hammer has a cross pein which is used for carefully placing small nails.

Hammers are available in a range of weights from 4oz. upwards. The handles are traditionally of ash or hickory wood. The head is fixed to the handle by wedges. Sometimes two wedges are used, one wood and one iron. It is good sense to check that the hammer head is quite secure before work starts. Some modern hammers have steel handles and a moulded rubber grip.

A common error when hammering is to grip too closely to the head. This means that the whole arm has to be swung whereas for most operations a grip at the end of the shaft and a wrist action are best. With practice, hammering can be very accurate and highly effective. Hammers are frequently used when fitting joints together. When doing this, use waste wood to prevent the surface of the work being bruised.

Mallets are mainly used for driving chisels when chopping out joints or carving. Made of beech wood, mallets are sold according to the size of the head, from 4″ - 6″ (100mm-150mm). The head is fixed by means of a tapered mortise which matches the taper of the handle. In use, the head becomes more and more tightly fixed and cannot fly off.



A claw hammer may be used for removing nails. Hammers should always be firmly gripped.

Nails and screws

For quick joints in carpentry and joinery, nails are used. For best results the correct nail for the job should be used. A guide to the most common types is shown at the end of this book.

When fixing wood of unequal thickness, the nail must be driven through the thinner into the thicker piece of wood. When corner jointing a simple box, it is useful to drive the nail at an angle, 'on the skew', to achieve a dovetail effect. To prevent splitting along the grain when several nails are used, they should be offset from each other, or 'staggered'.

Screws are a much more efficient means of joining wood than nails. They also have the added advantage that they can easily be removed. Screws are made of steel and brass, each with a variety of finishes – chromed, galvanised, black japanned – to improve their appearance or prevent rusting. Wood screws are classified in the following way: Size – length and diameter (gauge), material, and shape of head. An example: $1\frac{1}{2}$" No. 8 steel countersunk head. The higher the gauge number the thicker the screw. Some screws have special cruciform slots to give the screwdriver a better grip.

It should never be necessary to force a screw into wood. First a clearance hole, equal to the shank of the screw, should be drilled into the top piece. Then a bradawl, or a small drill, should make a pilot hole in the second piece. A screwdriver that fits the screw slot exactly must be used.

Rasps

Rasps are available in a variety of cuts – coarse, medium and smooth, in various lengths from 6 to 14 inches, and in several different shapes – flat, halfround and rat-tail (round).

Rasps are used for rough shaping in awkward places and on tight curves inaccessible to other tools. Because the teeth are coarse they tend to tear at the grain of the wood and a very rough surface is produced. This requires more work with abrasive papers before a satisfactory finish is obtained. Rasps also tend to clog badly and need to be cleaned frequently with a wire brush. The disadvantages of the traditional rasp have led to the development of one of the few really new woodworking tools – the shaper or 'Surform' tool.

This new tool works rather like a cheese grater. The waste is shaved away by a perforated blade with many little plane-like cutting edges. This shaving action produces quite a smooth surface when used with the grain, and the 'shavings' pass through the blade so that clogging is eliminated. The shaper tool is available in the form of a file or plane; one variation, the 'planer file', has an adjustable two-position handle. The blades are flat, half-round or rat-tail and renewable. Used with care each blade has a long life. Soft metals and plastics can also be worked.

The shaper, together with coping saw, bowsaw and abrasives can be used to produce attractive sculptures in wood.

Surform planerfile

Surform file

Surform round file

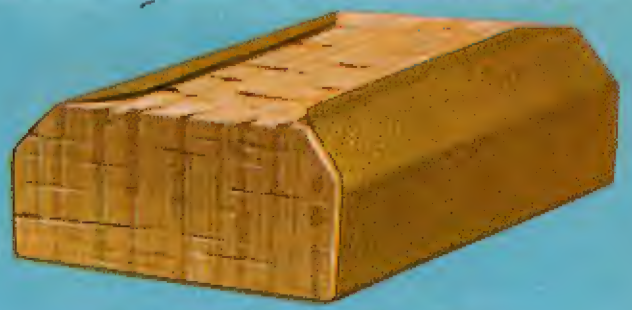
Abrasives

After using a smoothing plane but before applying a finish, abrasives are used to finally smooth the surface of the wood. Confusion is often caused because this is frequently called 'sanding' and the abrasive is referred to as 'sandpaper', the reason being that the early abrasives were made from sand glued to paper. Today the most common abrasives are glass papers. Crushed bottle glass is sieved to produce various *grits* to make papers in a range of coarseness. The *grade* is printed on the back of each sheet either in the English system (00, 0, 1, 1½, F2 etc.), the European system (220, 150, 120, 100, 80 etc.) or both.

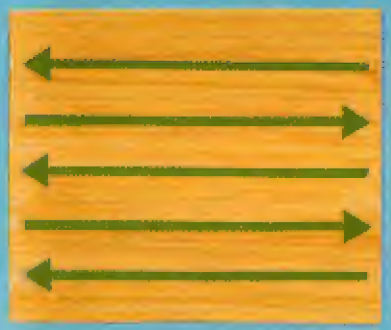
Abrasives of garnet, aluminium oxide, silicon carbide and tungsten carbide, in 'open' or 'close' coatings on a variety of backings – paper, cloth, fibre and metal – are available. Special discs and belts for power tools are produced.

When working on large flat surfaces, wrap the abrasive tightly round a cork block. This increases the area rubbed and ensures flatness. On complicated parts it is sometimes necessary to make up a specially shaped block. Rubbing strokes should always be along the grain. Never use a scrubbing action as this covers the surface with unsightly scratches. Excessive use of abrasives can spoil a piece of work. If edges are rounded off, the crisp appearance of the work will be lost. If joints are rubbed-down they will become ill fitting.

Abrasives are often used to *cut back* polished or painted surfaces in between coats; special *wet and dry* papers can be used for this purpose. In the final stages of brush polishing in preparation for a wax finish, *steel wool* can be used as an abrasive. This has an advantage over papers in that it does not clog.



Glass-paper pulled tightly around cork block



CORRECT
rubbing action with the grain

INCORRECT
scrubbing action

Glass-paper
list of grades: 00*(flour paper)*. 0 . 1 . 1½ . F2 . M2 . S2 . 2½ . 3

Adhesives and glues

Bonding wood with glue is a simple operation but needs careful planning and neatness. Basically, the glue is spread over the surfaces which are then cramped tightly together; this forces the glue into the hundreds of tiny pores in each piece. Later the glue sets and a strong bond is made. There are several types of glue available and the woodworker must select the most suitable for each job.

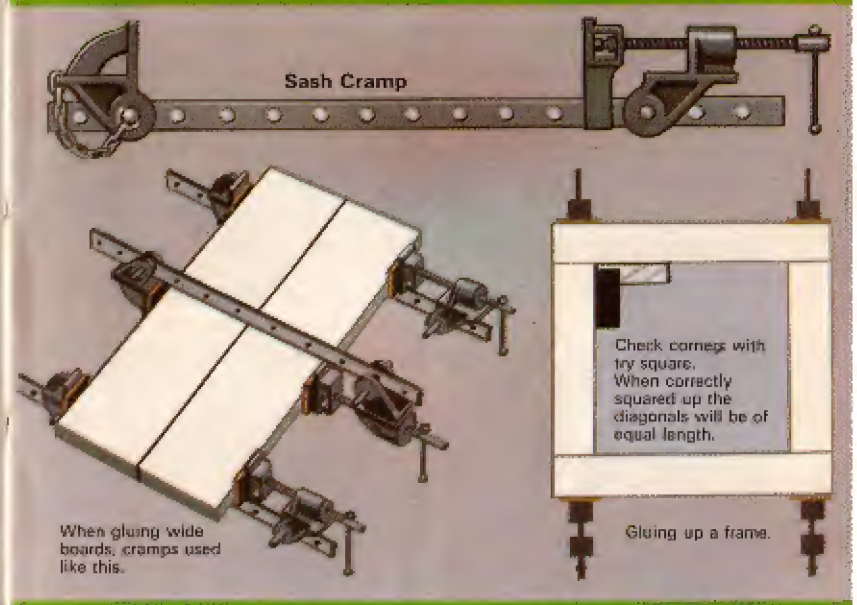
P.V.A. (Polyvinyl Acetate) is a creamy white emulsion usually sold ready-to-use in a plastic container. P.V.A. is water based and is used cold. Under cramping at room temperature, the glue sets in a few hours into a hard but flexible and almost colourless bond. P.V.A. glue is not completely waterproof and therefore used only on interior work.

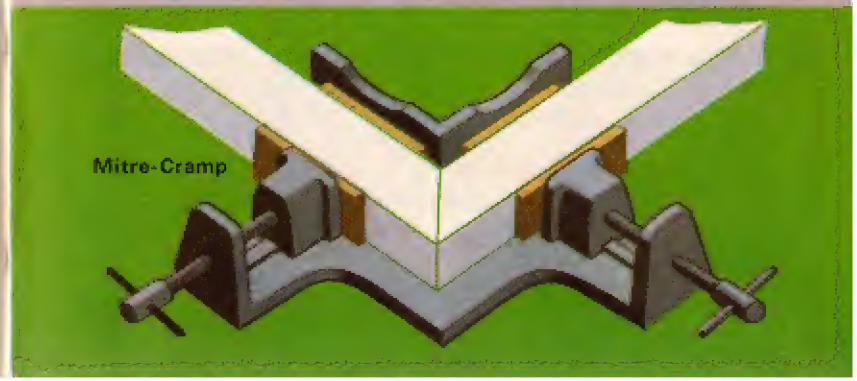
Casein glue is made from skimmed milk mixed with caustic soda and hydrated lime. Bought as a fine white powder it is mixed with water into a creamy consistency. The mixture rapidly hardens so it is important to mix only enough for the job in hand. Cramping time is very short. It is mainly for indoor work.

Animal glue is made from hides and bones and sometimes called Scotch glue. Mainly of gelatine, it is mixed with water and boiled in a glue kettle, and forms a good bond only if carefully prepared. It is very cheap and its stickiness is useful when fixing small intricate pieces. For indoor work only.

Synthetic resins are available in several forms. Some are two-part mixes consisting of resin and hardener. These glues set very quickly and tend to be brittle. Highly resistant to water, they are ideal for boat-building.

Contact (Impact) glues are rubber based and used mainly for bonding laminated plastics to wood. The glue is spread thinly on both parts, allowed to dry and then brought into contact. With only hand pressure the bond is immediate.





Finishing

Almost every woodwork job requires a finish of some kind to protect the surface from dirt, stains and moisture. Finishes seal the grain, reducing the likelihood of warping. Finishes enhance the appearance of a job by bringing out the full 'figure' (grain pattern) and colour of the wood. Every job and each wood has a finish most suitable for it.

Creosote is made of coal tar and is ideal for garden fences and similar jobs. It prevents rotting, and is cheap and easy to apply with a brush. For a teak garden seat *raw linseed oil*, or one of the specially formulated oils with synthetic resins, is best. In the damp steamy atmosphere of the bathroom, *paint* is best for cabinets and stools of softwood. Painting looks easy but each step – priming, filling, undercoating and final top coating – must be carried out with great care. *Enamels* give a bright and durable finish to children's toys.

A tea tray of hardwood needs a hard, heat resistant finish. *Catalysed lacquers* are specially made for this kind of work. The lacquer is bought in a two-part pack, lacquer and acid-based hardener. The two are mixed before use and brushed on. Usually fast drying, after rubbing down more coats can be added. *Wax polish* produces a fine sheen on all furniture. The wood is first sealed with a brush polish (a mixture of shellac and methylated spirits). After several coats, rubbing down between each, wax polishes are applied. Silicone waxes make the surface fairly resistant to water spills.

Varnish is oil-based and ideal for canoes and boats of marine plywood. A recently developed finish for the same type of work is *polyurethane* based.

Sometimes no finish is used at all for hygienic reasons. Wooden spoons, chopping boards and rolling pins of beech or teak are good examples.


Creosote


Oil


Paint


Enamel


Heat resistant acid catalysed lacquer


Wax


Varnish


Plain wood

Joints—frames

Wood can be jointed together in a great variety of ways. Constructions in wood can be conveniently divided into two groups – *frames* (chairs, tables and windows) and *boxes* – (cabinets, drawers, bookcases and so on). On these last two pages we deal with each group in turn. It is important to realise that not every joint is shown here but only some of the most common.

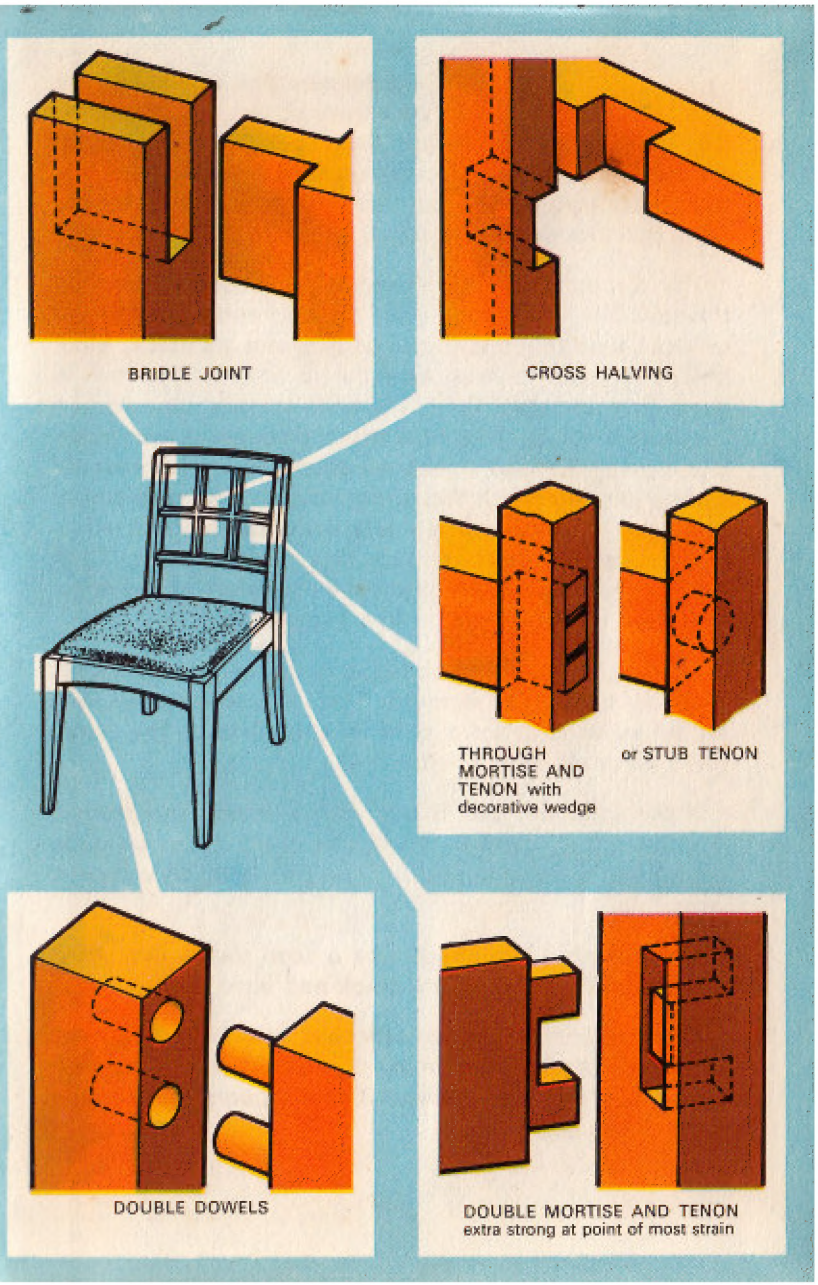
Opposite we have drawn a chair specially designed to include several frame joints.

The *cross-halving* joint. Half the thickness of each piece is cut away to form the cross. As in all joints, accurate marking-out, sawing and chiselling is vital if a well fitting joint is to be obtained. This joint could also be used when making the framework for a shed or fitting divisions in a workbox.

The *mortise and tenon* joint has many variations. The mortise is the 'hole' part of the joint, the tenon the close-fitting 'peg' part. The shoulders of the tenon must be very carefully sawn since this is the part of the joint which shows when the two parts are assembled. Large mortise and tenon joints are used on doors and window frames.

Dowel joints are often used as substitutes for mortise and tenons, especially in mass-production. If the holes are accurately positioned and carefully bored, a quick yet very strong joint results. Dowels can also be used to strengthen edge to edge joints in thick boards.

The corner *bridle joint* shown here, and the 'T' bridle joint, can also be used as alternatives to the mortise and tenon, especially in situations where angles other than right angles are required.



Joints—boxes

A sideboard and a seed tray are examples of box constructions. It is obvious that the jointing used in each case has to be different. Some common corner joints are shown here. It is from these, and others, that the most suitable joint for the work in hand must be selected.

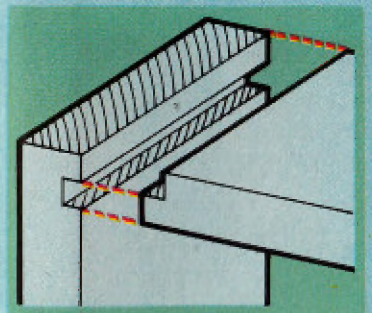
The *through dovetail,* sometimes called the common dovetail, is a very strong joint. Cutting and fitting all the dovetail-type of joints demands skill and accuracy. Most beginners need to seek expert help at first. The 'tail' is sawn first and then the 'pins' and 'sockets' are marked out from it. It is for this work that the special dovetail saw and the bevel-edged chisels are used. The *lapped dovetail* gives a joint on which the construction is only visible from one side; the drawer of a sideboard or dressing table is a good example to look at. In the *secret mitre dovetail* all of the construction is hidden except for the mitre on the edge. This joint is found only on fine cabinet work.

Housing joints are to be found in boxes with divisions, a cutlery drawer for example. The *stopped housing joint* would be used to fix a shelf in a bookcase. The 'stop' gives the front edge a neater look.

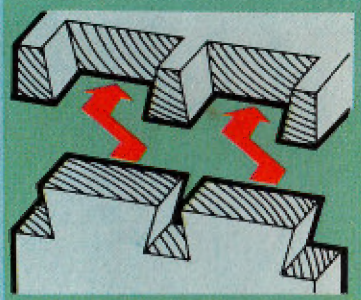
A simple corner joint is one with a *tongue and groove.* Accurately cut, carefully fitted and glued it can be quite strong and especially useful if the box is to be veneered later.

For making a simple job like a seed tray a *butt joint,* nailed together, provides a quick and easy solution.

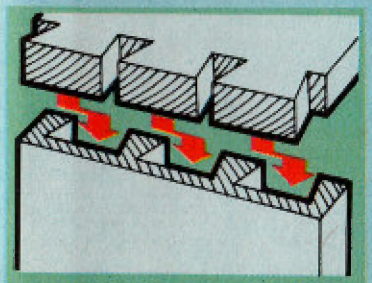
New materials, such as veneered chipboard and new, extra strong adhesives, make traditional joints inappropriate. New methods – dowels, fillets or patent fastenings – have to be used.



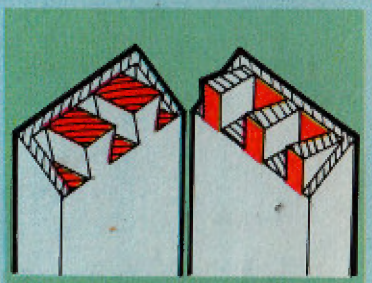
Tongue and grooved or lapped housing joint



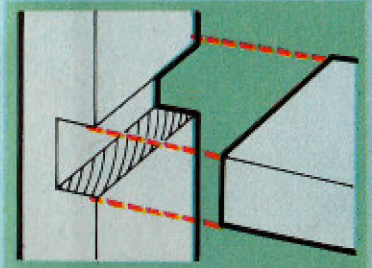
Through dovetail



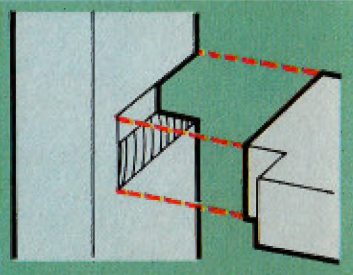
Lapped dovetail



Secret mitred dovetail
(Orange faces slide together)



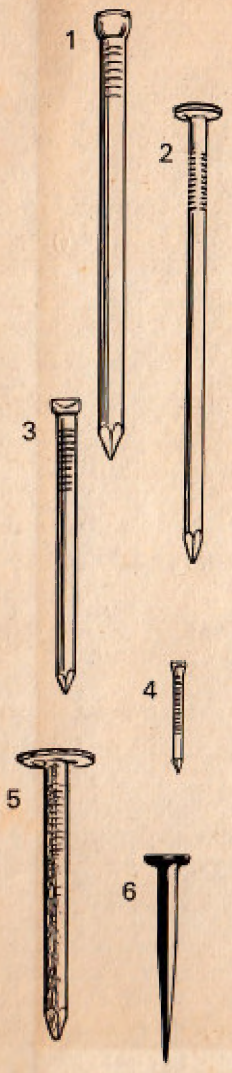
Through housing joint



Stopped housing joint

Series 634

Guide to most common nails



1. LOST HEAD or FLOOR BRADS, a round nail with a small bulb-shaped head which enables it to be completely driven below the surface. Used for fixing floor boards and similar jobs.
Sizes 2¼" and 3" (56mm and 75mm) long.

2. WIRE NAILS, made of steel, for general purpose work. They are easily withdrawn and therefore often used on packing cases.
From ¾" to 6" (18-150mm) long.

3. OVAL BRADS of steel with an oval cross-section to reduce the likelihood of splitting the wood. The small head is usually nail-punched below the surface and the cavity filled to give a neat appearance.
From ½" to 4" (12-100mm) long.

4. PANEL PINS for fixing thin plywood or hardboard, and made of round steel wire with a very slight head. Usually used in conjunction with glue. Special *HARDBOARD PINS* are obtainable; these are square in section and usually 'coppered' (i.e., coated with copper) to prevent rusting.
From ½" to 2" (12-50 mm) long.

5. CLOUTS are galvanised (zinc coated) and are used to fix down roofing felt.
From ⅜" to 2½" (15-62mm) long.

6. CUT TACKS have very sharp points and are used for upholstery work.
From ½" to 1" (12-25mm) long.